

WHAT IS CLAIMED IS:

1           1.     In a communications network having a plurality of communication units, wherein  
2     at least one of those units is designated as a routing unit for routing network traffic, a  
3     communication unit to transmit and receive messages within said network comprising:

4           a transmitter to transmit an outgoing message to each neighboring unit of said  
5     communication unit;

6           a receiver to receive an incoming message from said each neighboring unit;

7           a storage unit to store network connectivity information relating to said communication  
8     unit and corresponding neighboring units; and

9           a processor to control said transmission and reception of said outgoing and incoming  
10    messages, wherein said processor includes:

11           a configuration module to examine said network connectivity information and  
12    designate said communication unit as said routing unit in response to determining that said  
13    communication unit communicates with at least one neighboring unit that is isolated from  
14    communications with remaining neighboring units of said communication unit.

15           2.     The unit of claim 1 wherein said transmitter transmits said outgoing message in  
16    the form of radio signals.

17           3.     The unit of claim 1 wherein said receiver receives said incoming message in the  
18    form of radio signals.

19           4.     The unit of claim 1 wherein said processor further includes:

20           a status transmission module to facilitate transmission of a unit status message at a  
21    periodic time interval, wherein said unit status message includes unit connectivity information  
22    relating to network connectivity of said communication unit; and

23           a status reception module to facilitate reception of said unit status message from said each  
24    neighboring unit and to update said connectivity information within said storage unit in  
25    accordance with unit connectivity information contained within each received unit status  
26    message.

1           5.     The unit of claim 4 wherein said processor further includes:  
2           an interval module to adjust said periodic time interval in response to detecting  
3 modifications in network connectivity indicated by said updated connectivity information within  
4 said storage unit.

1           6.     The unit of claim 5 wherein said interval module further includes:  
2           an interval adjustment module to increase said periodic time interval in response to  
3 determining that a quantity of neighboring units of said communication unit is equal to said  
4 neighboring unit quantity of an immediately preceding periodic time interval.

1           7.     The unit of claim 4 wherein said configuration module further includes:  
2           a transmission interval module to maintain a count of unit status message transmissions  
3 by said communications unit and to determine when a predetermined quantity of said unit status  
4 messages has been transmitted;  
5           an evaluation module to determine the presence of modifications to said connectivity  
6 information within said storage unit during said unit status message transmissions; and  
7           a unit status module to determine said status of said communication unit as said routing  
8 unit in response to an absence of modifications to said connectivity information as determined  
9 by said evaluation module.

1           8.     The unit of claim 7 wherein said unit status module further includes:  
2           a routing status module to designate said communication unit as said routing unit in  
3 response to determining that said communication unit communicates with at least one  
4 neighboring unit that is isolated from communications with remaining neighboring units of said  
5 communication unit;  
6           a master status module to designate said communication unit as a master unit in response  
7 to determining that said communication unit and each neighboring unit are in communication  
8 with the same units and said communication unit is associated with an identifier superior to  
9 identifiers of said neighboring units; and  
10          a member status module to designate said communication unit as a member unit of a  
11 corresponding routing unit in response to said master status module determining that said

12 communication unit and each neighboring unit are in communication with at least one different  
13 unit and said routing status module determining that said communication unit fails to qualify as  
14 said routing unit.

1 9. The unit of claim 8 wherein said master status module further includes:  
2 a routing unit selection module to determine said status of said neighboring units as said  
3 routing and member units in response to said communication unit being designated as said master  
4 unit; and  
5 a status transmission module to facilitate transmission of status information to  
6 neighboring designated routing units to inform those units of their designation as routing units  
7 by said communication unit serving as said master unit.

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3 an update module to receive an update message from a neighboring transmission routing  
4 unit in response to said communication unit being designated as said routing unit and to update  
5 said link storage unit with said connectivity information contained within said received update  
6 message;

7 a data integrity module to examine said network connectivity information within said link  
8 storage unit and determine information missing from said link storage unit in response to said  
9 update by said update module; and

10 a request module to request said neighboring transmission routing unit to transmit said  
11 missing information in response to said data integrity module determining that information is  
12 missing from said link storage unit.

1 13. The unit of claim 12 wherein said routing unit configuration module further  
2 includes:

3 a request processing module to receive said request from a neighboring routing unit in  
4 response to said communication unit being designated as a transmission routing unit and to  
5 process said received request to transmit information identified in said request to that  
6 neighboring routing unit.

1 14. The unit of claim 11 wherein said message forwarding module further includes:

2 a data accumulation module to accumulate information received within plural update  
3 messages and to transmit said accumulated information in the form of a single transmission to  
4 neighboring routing units to facilitate synchronization of said link storage unit of said each  
5 routing unit.

1 15. The unit of claim 11 wherein said message forwarding module further includes:

2 a timer to indicate expiration of periodic reception intervals; and

3 a data accumulation module to accumulate information received within each of said  
4 periodic reception intervals and to transmit said accumulated information of each periodic  
5 reception interval in the form of a single transmission to neighboring routing units at expiration  
6 of that periodic reception interval to facilitate synchronization of said link storage unit of said  
7 each routing unit.

1           16. In a communications network having a plurality of communication units, wherein  
2 at least one of those units is designated as a routing unit for routing network traffic, a method of  
3 configuring a network communication unit to transmit and receive messages within said network  
4 comprising the steps of:

5           (a) examining network connectivity information relating to said communication unit  
6 and corresponding neighboring units stored in a storage unit of said communication unit; and

7           (b) designating said communication unit as said routing unit in response to  
8 determining that said communication unit communicates with at least one neighboring unit that  
9 is isolated from communications with remaining neighboring units of said communication unit.

1           17. The method of claim 16 wherein said messages are transmitted in the form of  
2 radio signals.

3           18. The method of claim 16 wherein step (a) further includes:

4           (a.1) transmitting a unit status message at a periodic time interval, wherein said unit  
5 status message includes unit connectivity information relating to network connectivity of said  
6 communication unit; and

7           (a.2) receiving said unit status message from said each neighboring unit and updating  
8 said connectivity information within said storage unit in accordance with unit connectivity  
9 information contained within each received unit status message.

1           19. The method of claim 18 wherein step (a) further includes:

2           (a.3) adjusting said periodic time interval in response to detecting modifications in  
3 network connectivity indicated by said updated connectivity information within said storage unit.

4           20. The method of claim 19 wherein step (a.3) includes:

5           (a.3.1) increasing said periodic time interval in response to determining that a quantity  
6 of neighboring units of said communication unit is equal to said neighboring unit quantity of an  
7 immediately preceding periodic time interval.

8           21. The method of claim 18 wherein step (b) further includes:

2 (b.1) maintaining a count of unit status message transmissions by said communications  
3 unit and determining when a predetermined quantity of said unit status messages has been  
4 transmitted;

5 (b.2) determining the presence of modifications to said connectivity information within  
6 said storage unit during said unit status message transmissions; and

7 (b.3) determining said status of said communication unit as said routing unit in  
8 response to an absence of modifications to said connectivity information as determined in step  
9 (b.2).

1 22. The method of claim 21 wherein step (b.3) further includes:

2 (b.3.1) designating said communication unit as said routing unit in response to  
3 determining that said communication unit communicates with at least one neighboring unit that  
4 is isolated from communications with remaining neighboring units of said communication unit;

5 (b.3.2) designating said communication unit as a master unit in response to determining  
6 that said communication unit and each neighboring unit are in communication with the same  
7 units and said communication unit is associated with an identifier superior to identifiers of said  
8 neighboring units; and

9 (b.3.3) designating said communication unit as a member unit of a corresponding routing  
10 unit in response to step (b.3.2) determining that said communication unit and each neighboring  
11 unit are in communication with at least one different unit and step (b.3.1) determining that said  
12 communication unit fails to qualify as said routing unit.

1 23. The method of claim 22 wherein step (b.3.2) further includes:

2 (b.3.2.1) determining said status of said neighboring units as said routing and  
3 member units in response to said communication unit being designated as said master unit; and

4 (b.3.2.2) transmitting status information to neighboring designated routing units to  
5 inform those units of their designation as routing units by said communication unit serving as  
6 said master unit.

1 24. The method of claim 16 further including:

2 (c) examining network connectivity information relating to routing units stored within

3 a link storage unit of said communication unit in response to said communication unit being  
4 designated as said routing unit; and

5 (d) designating said communication unit as a transmission routing unit in response  
6 to determining that said communication unit communicates with at least one neighboring routing  
7 unit that is isolated from communications with remaining neighboring routing units of said  
8 communication unit.

1 25. The method of claim 24 wherein said transmission routing unit transmits update  
2 messages including network connectivity information, and step (d) further includes:

3 (d.1) receiving an update message from a neighboring transmission routing unit in  
4 response to said communication unit being designated as said transmission routing unit and  
5 transmitting said received message to neighboring routing units to facilitate synchronization of  
6 said link storage unit of each said routing unit.

1 26. The method of claim 25 wherein step (d) further includes:

2 (d.2) receiving an update message from a neighboring transmission routing unit in  
3 response to said communication unit being designated as said routing unit and updating said link  
4 storage unit with said connectivity information contained within said received update message;

5 (d.3) examining said network connectivity information within said link storage unit and  
6 determining information missing from said link storage unit in response to said update by step  
7 (d.2); and

8 (d.4) requesting said neighboring transmission routing unit to transmit said missing  
9 information in response to step (d.3) determining that information is missing from said link  
10 storage unit.

1 27. The method of claim 26 wherein step (d) further includes:

2 (d.5) receiving said request from a neighboring routing unit in response to said  
3 communication unit being designated as a transmission routing unit and processing said received  
4 request to transmit information identified in said request to that neighboring routing unit.

1 28. The method of claim 25 wherein step (d.1) further includes:

2 (d.1.1) accumulating information received within plural update messages and transmitting  
3 said accumulated information in the form of a single transmission to neighboring routing units  
4 to facilitate synchronization of said link storage unit of said each routing unit.

1 29. The method of claim 25 wherein step (d.1) further includes:  
2 (d.1.1) indicating expiration of periodic reception intervals; and  
3 (d.1.2) accumulating information received within each of said periodic reception intervals  
4 and transmitting said accumulated information of each periodic reception interval in the form of  
5 a single transmission to neighboring routing units at expiration of that periodic reception interval  
6 to facilitate synchronization of said link storage unit of said each routing unit.

1 30. A communications network comprising:  
2 a plurality of communication units to transmit and receive messages within said network,  
3 wherein each said communication unit includes:  
4 a status transmission module to facilitate transmission of a unit status message  
5 at a periodic time interval;  
6 an interval module to adjust said periodic time interval in response to detecting  
7 modifications in network connectivity; and  
8 a configuration module to determine a status of that communication unit as a  
9 routing unit for routing network traffic or as a member unit of a corresponding routing unit in  
10 accordance with information contained within received unit status messages.

1 31. The network of claim 30 wherein said each communication unit transmits  
2 messages in the form of radio signals.

1 32. The network of claim 30 wherein said interval module further includes:  
2 an interval adjustment module to increase said periodic time interval in response to  
3 determining that a quantity of neighboring units of that communication unit is equal to said  
4 neighboring unit quantity of an immediately preceding periodic time interval.

1 33. In a communications network including a plurality of communication units to



2 transmit and receive messages within said network, a method of transmitting and receiving  
3 messages comprising the steps of:

4 (a) transmitting a unit status message from each communication unit at a  
5 corresponding periodic time interval;

6 (b) adjusting said periodic time interval in response to a corresponding  
7 communication unit detecting modifications in network connectivity; and

8 (c) determining a status of said each communication unit as a routing unit for routing  
9 network traffic or as a member unit of a corresponding routing unit in accordance with  
10 information contained within received unit status messages.

1 34. The method of claim 33 wherein said each communication unit transmits  
2 messages in the form of radio signals.

3 35. The method of claim 33 wherein step (b) further includes:

4 (b.1) increasing said periodic time interval in response to determining that a quantity  
5 of neighboring units of a corresponding communication unit is equal to said neighboring unit  
6 quantity of an immediately preceding periodic time interval.

7 36. A communications network comprising:

8 a plurality of communication units forming a first network tier to transmit and receive  
9 messages within said network, wherein at least one of said communication units is designated  
10 as a routing unit to form a second network tier to route network traffic and at least one of said  
11 designated routing units is designated as a transmission routing unit to form a third network tier  
12 to transmit network information throughout said second and third network tiers, and wherein  
each said communication unit includes:

a configuration module to determine a status of that communication unit as said  
routing unit for routing network traffic or as a member unit of a corresponding routing unit; and

a routing unit configuration module to determine a status of that communication  
unit as a transmission routing unit in response to that communication unit being designated as  
said routing unit.

1           37.    The network of claim 36 wherein said each communication unit transmits  
2 messages in the form of radio signals.

1           38.    The network of claim 36 wherein said configuration module further includes a unit  
2 designation module to examine network connectivity information relating to that communication  
3 unit and to designate that communication unit as said routing unit in response to that  
4 communication unit communicating with at least one neighboring unit that is isolated from  
5 communications with remaining neighboring units of that communication unit.

1           39.    The network of claim 36 wherein said routing unit configuration module further  
2 includes a routing unit designation module to examine network connectivity information relating  
3 to designated routing units stored within a link storage unit of that communication unit and to  
4 designate that communication unit as a transmission routing unit in response to that  
5 communication unit communicating with at least one neighboring routing unit that is isolated  
6 from communications with remaining neighboring routing units of that communication unit.

1           40.    The network of claim 39 wherein said transmission routing unit transmits update  
2 messages including network connectivity information, and said routing unit configuration module  
3 further includes:  
4

5           a message forwarding module to receive an update message from a neighboring  
6 transmission routing unit in response to that communication unit being designated as said  
7 transmission routing unit and to transmit said received message to neighboring routing units of  
8 that communication unit to facilitate synchronization of said link storage unit of each said routing  
unit.

1           41.    The network of claim 40 wherein said routing unit configuration module further  
2 includes:

3           an update module to receive an update message from a neighboring transmission routing  
4 unit in response to that communication unit being designated as said routing unit and to update  
5 said link storage unit of that communication unit with said connectivity information contained  
6 within said received update message;

7 a data integrity module to examine said network connectivity information within a link  
8 storage unit of that communication unit and determine information missing from that link storage  
9 unit in response to said update by said update module; and

10 a request module to request said neighboring transmission routing unit to transmit said  
11 missing information in response to said data integrity module determining that information is  
12 missing from said link storage unit of that communication unit.

1 42. The unit of claim 41 wherein said routing unit configuration module further  
2 includes:

3 a request processing module to receive said request from a neighboring routing unit in  
4 response to that communication unit being designated as a transmission routing unit and to  
5 process said received request to transmit information identified in said request to that  
6 neighboring routing unit.

7 43. The network of claim 40 wherein said message forwarding module further  
8 includes:

9 a data accumulation module to accumulate information received within plural update  
10 messages and to transmit said accumulated information in the form of a single transmission to  
11 neighboring routing units of that communication unit to facilitate synchronization of said link  
12 storage unit of said each routing unit.

1 44. The network of claim 40 wherein said message forwarding module further  
2 includes:

3 a timer to indicate expiration of periodic reception intervals; and

4 a data accumulation module to accumulate information received within each of said  
5 periodic reception intervals and to transmit said accumulated information of each periodic  
6 reception interval in the form of a single transmission to neighboring routing units of that  
7 communication unit at expiration of that periodic reception interval to facilitate synchronization  
8 of said link storage unit of said each routing unit.

1 45. In a communications network including a plurality of communication units

forming a first network tier to transmit and receive messages within said network, wherein at least one of said communication units is designated as a routing unit to form a second network tier to route network traffic and at least one of said designated routing units is designated as a transmission routing unit to form a third network tier to transmit network information throughout said second and third network tiers, a method of configuring said network including the steps of:

(a) determining a status of each communication unit as said routing unit for routing network traffic or as a member unit of a corresponding routing unit; and

(b) determining a status of each communication unit as said transmission routing unit to transmit said network information throughout said second and third network tiers in response to that communication unit being designated as said routing unit.

46. The method of claim 45 wherein said each communication unit transmits messages in the form of radio signals.

47. The method of claim 45 wherein step (a) further includes:

(a.1) examining network connectivity information relating to each communication unit and designating as said routing unit each communication unit communicating with at least one neighboring unit isolated from communications with remaining neighboring units of that communication unit.

48. The method of claim 45 wherein step (b) further includes:

(b.1) examining network connectivity information relating to designated routing units and stored within a link storage unit of said each communication unit and designating as said transmission routing unit each communication unit that communicates with at least one neighboring routing unit isolated from communications with remaining neighboring routing units of that communication unit.

49. The method of claim 48 wherein said transmission routing unit transmits update messages including network connectivity information, and step (b) further includes:

(b.2) receiving an update message from a corresponding neighboring transmission routing unit at each communication unit designated as said transmission routing unit and

transmitting said received message to neighboring routing units of that communication unit to facilitate synchronization of said link storage unit of each said routing unit.

50. The method of claim 49 wherein step (b) further includes:

(b.3) receiving an update message from a corresponding neighboring transmission routing unit at each communication unit designated as said routing unit and updating said link storage unit of that communication unit with said connectivity information contained within said received update message;

(b.4) examining said network connectivity information within said link storage unit of each communication unit and determining information missing from that link storage unit in response to said update by said update module; and

(b.5) requesting said corresponding neighboring transmission routing unit of each communication unit designated as said routing unit to transmit said missing information in response to said data integrity module determining that information is missing from a link storage unit of that communication unit.

51. The method of claim 50 wherein step (b) further includes:

(b.6) receiving at each communication unit designated as said transmission routing unit said request from a corresponding neighboring routing unit and processing said received request to transmit information identified in said request to that neighboring routing unit.

52. The method of claim 49 wherein step (b.2) further includes:

(b.2.1) accumulating information received within plural update messages at each communication unit designated as said transmission routing unit and transmitting said accumulated information in the form of a single transmission to corresponding neighboring routing units of that communication unit to facilitate synchronization of said link storage unit of said each routing unit.

53. The method of claim 49 wherein step (b.2) further includes:

(b.2.1) indicating expiration of periodic reception intervals; and

(b.2.2) accumulating information received within each of said periodic reception intervals

4 at each communication unit designated as said transmission routing unit and transmitting said  
5 accumulated information of each periodic reception interval in the form of a single transmission  
6 to corresponding neighboring routing units of that communication unit at expiration of that  
7 periodic reception interval to facilitate synchronization of said link storage unit of said each  
8 routing unit.